Adjusting Your Methods: Teaching Mathematics with an Online Curriculum

An Honors Thesis (HONR 499)

by

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June 2015

Date of Graduation

December 2014

Abstract

As educators consider how new technologies can be used in schools to improve student learning, teachers must adjust how they plan for teaching, instruct during a class period, and assess student knowledge. In the following article, I discuss how use of an online mathematics curriculum affects the teachers' role with respect to planning, instruction, and assessment. I incorporate research from educational studies, the experiences of teaching professionals, and my own classroom practices to help teachers anticipate and analyze how they can adjust their teaching when implementing an online curriculum in a mathematics classroom. The article is written following the submission guidelines for a National Council of Teachers of Mathematics journal.

Acknowledgements

I would like to thank Dr. Elizabeth Bremigan for advising me through this project. Her continuous support and guidance has helped create a more fulfilling university experience.

I would also like to thank Michael, Peggy, and Tommaso for encouraging me to complete my project.

Can you think of the most recent way you communicated with someone in your family? Did you talk to someone in person? Did you text your husband or wife about dinner plans for the evening? Did you call your brother to ask him about his new job? When was the last time you wrote a letter by hand instead of typing an email to send someone a message?

The ways in which humans communicate have evolved with new technologies. The same holds true for how teachers communicate content to students in a mathematics course. The curriculum materials for a mathematics course have developed from a simple slate and chalk to cassettes and CD-ROMs, and now school systems are providing laptops or tablets for every student. Online and web-based curriculums are becoming more abundant in the mathematics classroom. Educators have to adjust their planning procedures, instructional methods, and assessment strategies to be effective teachers in an evolving educational environment. The question for educators becomes, "How does this technology change my teaching, and how can I use these new technologies and web-based curricula to sustain effective teaching?"

I have had firsthand experience teaching with an online curriculum in my own classroom. While teaching an Algebra I course, I used Agile Mind as the primary curriculum for student learning. Learinglist.com (2014) describes Agile Mind as a "comprehensive, online program to support mathematics instruction in middle school and high school." The program's website asserts support for teacher instruction through animations and real-world simulations, formative assessment components, real-time reporting of student progress, and day-by-day lesson support for each of the courses

offered by the company (Agile Mind, 2015). Each course is aligned to the Common Core State Standards as well as the Texas Essential Knowledge and Skills Standards.

Students observe course pages with listed topics that should be viewed and studied in the designated order. For each topic, the program includes an overview, a section for exploring the topic, a topic summary, assessment pieces, and a testing section. The topics typically present a real-world situation to introduce and explore the content contained in that section. Students are guided through variations of the original story to build upon their knowledge in each step of the topic and throughout the course. Agile Mind uses spiraling to revisit previous topics and tie together the course content. Teachers see the same content as the students, but they also have access to program features to assign tasks, analyze data, and print activity sheets for students to record information throughout the topic.

The Agile Mind curriculum contains a wealth of resources for students and teachers to aid learning and instruction, and I have learned to navigate how these resources should be used to assist the educational process. Lesson planning, instruction, and assessment all must be adjusted from traditional teaching methods to incorporate new technologies in the classroom.

Planning

When using a traditional text as the core of a mathematics unit, it is fairly simple to plan a lesson that includes goals or objectives, an introduction, a set of procedures for implementing the lesson, and an assessment piece. Many textbooks published within the last twenty years provide teachers with tools and tips for every lesson. For

example, the teacher's edition of an Algebra II textbook (Carter, 2012) provides all of the following for a single lesson about graphing quadratic functions: an index of skills to be learned, a prerequisite knowledge review, a vocabulary list, leading questions that stem from prior knowledge, in-class examples, teaching tips and suggestions for certain examples, differentiated instruction tools, and small assessment pieces.

To plan for a new lesson with a printed textbook, the teacher could simply familiarize himself with the resources given by the text and decide which parts of the lesson would be best for students and the teaching environment. For example, the teacher has to decide what vocabulary words in the lesson are important, which examples to show students, and how he will motivate students to complete the tasks. This is only a small part of the planning process, however. Unless every teacher is given supplemental materials that mirror the textbook's lessons, there is no presentation material or pre-made diagrams to display to the class. These supplemental materials are available, but are resources often left out of a school district's purchases because of the cost. The teacher must decide what and how he is going to present to students. The teacher is responsible for creating more of the lesson instead of just choosing a lesson plan and implementing it. Typically students have their own textbooks or workbooks that follow the lesson and textbook companies give supplemental examples or problems to use with each lesson; the difficulty of providing extra materials for students is decreased by utilizing the lessons set out by the text.

Planning with an online curriculum functions in a much similar way. A program like Agile Mind provides professional support for each topic in the course. A set of goals and objectives, day-to-day lesson timeline, a series of required prerequisite skills, a list

of necessary materials, and language support for native and non-native speakers are all part of a topic's planning guides. Planning to teach a new concept with an online curriculum that contains types of resources for educators seems fairly simple. A classroom teacher without education in teaching with an online curriculum might believe that he has a new medium through which to find resources but see his role in planning as essentially the same as before. However, with this particular online curriculum, teachers are virtually eliminated from the planning process. The lesson is already designed, compiled, and ready to teach by anyone as long as the appropriate materials are available to students and teachers. An anonymous blogger writes on his website, "We are essentially teaching someone else's lesson. In order to do this, you have to actually look through the lesson and figure out the point that someone else is trying to make. ...trying to teach what someone else has created is a different sort of task" ("I Hate Agile Mind," 2012). This might make planning "easier" for some teachers, but for others it negates the idea that teachers bring a professional, creative, unique mind to every lesson that has a right and purpose to be shared with students.

Flexibility is arguably one of the most important components of planning in a dynamic classroom environment. By solely using the plans determined by the available curriculum, the teacher loses flexibility that is afforded by self-created materials and lessons centered on the specific students in the class. Traditional textbooks typically give an abundance of examples, practice problems, and prerequisite skill checks in every lesson, so adjusting practice or choosing new examples is more easily done. An online curriculum may be limited in the number of examples it provides, and some

curriculums may not even allow teachers or students to move back to a previous lesson or pass to an upcoming lesson.

What teachers using online curriculums must remember is that planning a lesson with a web-based program does not mean that they must limit their planning to the materials provided by the online curriculum. If a textbook were not providing students with the support they needed, any trained educator would know to seek out additional resources for the next lesson. Online curricula should be held to the same standard. Although a majority of a course's resources could stem from a web-based program, a teacher should always plan with the students' best interest in mind. A curriculum that furnishes a large number of pre-made worksheets, professional support systems, and visual animations may help teachers begin to compile the resources needed for an effective lesson, but a teacher must know how to plan for student understanding, not how to plan "easier" for himself. The resources provided by these online curriculums are a starting point for planning rigorous instruction.

Educators adopting an online curriculum also have to plan for the physical and technological limitations of his or her classroom environment. Most web-based curricula need a desktop computer or laptop with internet capabilities to operate. Agile Mind courses are also fully operational for tablets and iPads for more individual learning. However, if every student cannot access the curriculum by himself, the elements of the program are compromised. Having every student view the same screen at once on a large projector unifies the class's learning, but it reduces the students' individualized learning experience. As stated in his blog *Teaching is Not a Four-Letter Word*, Tom DeRosa (2007) explains his experience with Agile Mind saying, "If you don't have time

for or access to a functioning computer lab...only the animations are useful as an aid in introducing, clarifying or reteaching a given topic." Without individual student access to the program, the drag-and-drop activities and small formative assessment items are less effective in engaging students and assessing their knowledge. A teacher who uses an online curriculum must know exactly how students will be able to experience the curriculum; this awareness will strongly influence the planning of lessons and activities that broaden engagement and focus student learning.

Instruction

Implementing a traditional curriculum keeps teachers very busy during a class period. A teacher who structures a class with a textbook as the primary content resource requires more organizational efforts from his students and from himself. In observing these types of classes, one may see the teacher copying problems from the book and solving examples on the board. Maybe the teacher is asking students to copy definitions from the text onto a sheet of lined paper in their notebooks. The teacher has to draw arrows, use various colors of markers to make annotations, and stop and explain each step to ensure student understanding.

An online curriculum reduces the classroom teacher's need to write at the board. The teacher can simply click through slides and use his voice rather than his body to present material. The teacher can now be a true facilitator or translator of mathematics content rather than a presenter of material. With many online curricula, students already have the material in front of them displayed on a computer or tablet. Time in class is not used to copy the teacher's notes onto the board and then make sure that students are

copying these same notes onto their own papers. Although taking notes is a staple of mathematics learning, a study from the University of Michigan reported Johnstone and Su's (1994) findings that "inaccuracies in student notes occur most frequently when students are copying diagrams, numerical figures, equations, and items on transparencies-much of which is essential material." Teachers then have to ask themselves, "Is having students take notes an effective way to teach them mathematics?"

An online curriculum allows teachers the freedom to forgo traditional methods of instruction to introduce new and possibly more effective approaches to teaching. A teacher who moves away from his position at the board or behind the desk is available to roam the room to use proximity for classroom management. The teacher's voice and explanations of content can be the focus for students, not their quick writing or attempts to make sure they "have it all written down" before it is erased from the chalkboard. An online curriculum allows graphics, manipulatives, and diagrams to be available to students in a way that cannot be duplicated with traditional teaching. The curriculum is usually well designed and well researched. Students are able to return to the material whenever they have the internet at their disposable.

The idea that a sophisticated curriculum drives student learning rather than the teacher is revolutionary. Companies and educational forums that develop these types of online curriculums see the future of student learning in the merit of the student's technology; however, as suggested by the anonymous blogger for "I Hate Agile Mind", maybe students are not successful because of these new online curricula. The blogger posts, "But the reality is that students don't succeed because of greatly designed

curriculum. If so, they could just all stay at home and log in and learn by themselves. They succeed because of me the teacher pushing and motivating them" (2012). My personal experiences as an educator and student lead me to believe that this statement has merit. What is my purpose as a classroom teacher if it is not to teach my students? In these cases, the word "teach" becomes subjective. With an online curriculum, a teacher is the facilitator of highly researched and practiced classroom material. There may not be as much freedom for a teacher to pick and choose the material that is taught, and choosing to integrate his own methods of teaching that differ greatly from the online curriculum may disrupt student learning. In these scenarios the teacher then does not stand in front of a class for direct instruction or become the focus of the room. The students work at their own paces and center their focus on the curriculum or program to learn. Students have more responsibility to interpret the information by themselves. Without an online curriculum, students are reliant on the teacher for information. The educator is the base of student learning because he is the primary source for student knowledge, motivation, understanding, and success. The teacher leads the students to information, and then students model the teacher's actions and thought processes.

Of course, any educator that has researched learning strategies knows that collaborative working among students is vital for student learning, but computers and handheld or compact technologies are extremely personal. An online curriculum makes it difficult for teachers to incorporate this collaborative work without ostracizing students whose computer or tablet is not being used. Online curriculums may ease planning, but they complicate how students will communicate. With a computer in front of them and

the internet at their fingertips, what reason do students have to work with peers other than "because the teacher said so?"

As mentioned before, Agile Mind and other online curricula boast instruments for individualized instruction. Often students are given a task that they can complete at their own pace. Students who are ready to move ahead in the program will have access to upcoming material, and students who struggle with a topic may have the chance to revisit and further explore the concept without feeling embarrassed by asking questions in front of the class. This situation seems ideal for most classroom settings; students who need more help have access to more support, and students who need a challenge have the resources available to acquire a deeper understanding of the material. The problems arise when the teacher must give group instruction. Group instruction is a challenge with any curriculum, traditional or web-based, because of the varying readiness levels of every student. However, if students are working at their own pace it can be difficult to centralize a lesson that will be relevant for all students. Teaching a singular course is hard enough, but with every student working at a different speed or learning various concepts, the teacher might be preparing two, four, or twenty-four lessons to teach to his students.

Ted Mero from the Center for Digital Education published an article about the VOISE Academy in Chicago, Illinois. This school attempted to combine computer learning with classroom discussion and projects during the school day. "English class, for example," Mero writes, "will last 100 minutes, with half the time devoted to individualized work on the computer and the other half centered on class discussions and group work" (2008). What VOISE Principal Todd Yarch says next in the article

is indeed a typo)

caught my attention. Yarch imagines that during the half of th teachers' students are removed from their computers, he says, "This is our teacher's time to be teachers. To do some things that you would get in a good, traditional classroom. Project-based things, like full class discussions and small group discussions. I envision a classroom where I walk in and can't find a teacher because they're sitting next to the students" (Mero, 2008). His ideas suggest that teachers cannot be teaching when students are using their computers. If the use of an online curriculum is a necessary part of teaching mathematics, then there has to be room for the teacher to facilitate learning without a computer.

The computer and online curriculum cannot be a replacement for the motivation, encouragement, knowledge, and experience that a teacher brings to a classroom to instruct students. Teachers do not stop being teachers just because they are not leading a discussion or giving directions. Teachers have to learn how to teach with computers and online curriculums. Understanding the curriculum, knowing how students will interpret the information, and being open to trying new approaches to teaching and learning may change the teacher's actions during instruction, but it does not change the need for the presence of the teacher in the classroom.

Assessment

Three broad functions for assessment are supporting learning or formative assessment, certifying the achievements of potential of individuals or summative assessment, and evaluating the quality of educational programs and institutions or evaluative assessment (Lester, 2007). As far as classroom teaching is concerned,

online curricula can change the way traditional teachers implement formative and summative assessment. Assessment components of online curricula can require less time to collect data, can be analyzed for errors and misunderstandings, and make using technology for assessment a regular part of the course experience. Teachers have to adjust to these changes, but more technology in the classroom may mean more frequent and more accurate ways to assess students.

Assessment has always been a part of the conventional educational system. Homework, tests, quizzes, and other summative assessments were key to evaluate student performance. Teachers were usually the "givers" of these types of assessments. The teacher gives a student the test, the student completes the work, and then the teacher awards a grade determined by the students' work. Educators were the beginning and the end for students when it came to learning and earning their grades. However, an online curriculum like Agile Mind gives students autonomy and places more accountability on the students' abilities to be responsible for their learning. Imagine, for instance, that you are observing an Algebra II class that is using Agile Mind to learn about functions. You might see students on laptops or tablets viewing and clicking through screens, reading about how inverse functions and exponential functions are graphed. However, in between these stages of reading and understanding, students are asked to check their comprehension by completing a simple task: true or false questions, drag-and-drop short answer, multiple choice, completing a pattern, etc. Students are individually responsible for completing this portion of the topic. The teacher is not hovering over a student's shoulder immediately pointing out incorrect responses; the student is responsible for moving forward in the lesson after he has

answered the question, at which point the program will identify for students what parts of the response are incorrect. The responsibility of pacing, understanding, and assessing migrates from the teacher to the student. Students who encounter formative assessment pieces, either formal or informal, can become more self-sufficient learners and even more reflective students (Boboc and Vonderwell, 2013).

With an online curriculum, a teacher may have to assign certain tasks to students so that they may complete them. After all, it is very difficult for teachers to document how much and how well students are learning if there is no standard from which to compare students. For example, with the ALEKS (Assessment and Learning Knowledge Spaces) computer-based curricula, teachers or supervisors can assign quizzes and assessments to students, but every student will not see the same material to prepare for that test. The program's website describes how ALEKS chooses what concepts a student will see: "ALEKS uses adaptive questioning to quickly and accurately determine exactly what a student knows and doesn't know in a course. ALEKS then instructs the student on the topics she is most ready to learn" (What is ALEKS?, 2014). It may be less time consuming and highly individualized for each student to provide a program that targets student needs, however, if a student is not "ready" to learn a particular topic for any reason, assigning an assessment component becomes trivial instead of helpful in formative or summative assessment.

As students are working at their own pace, teachers cannot simply ask for students to complete a quiz or bell work activity for a topic that not every student has encountered. Online curricula make it easier for teachers to track what individual students have mastered, but it does not always simplify how students see themselves

as a progressive, dynamic, learning individual with the class. An educator using an online curriculum must decide how and when every individual student should be assessed. A "one-size fits all" approach to summative assessment will not be possible for a classroom that has diverse learners at varying stages in their mathematical understanding.

Time and resources can also affect what a teacher asks of his students. He might require students to complete an activity sheet for one of the program's topics at home, or maybe a guided assessment could be given as a "take-home quiz." However, these assignments are contingent on students having access to the internet at a location away from school. School districts may be able to provide a wealth of resources in the confines of an academic building, but it is rare that schools can provide these resources for every household in the district. A mathematics teacher using an online curriculum has to be deliberate in making his students' educational experiences equitable. For example, students without internet access at home may not have the same opportunities to study for tests and quizzes. Grades could be skewed because of the advantages and disadvantages with which students are confronted. The use of an online curriculum may rely very little on students producing physical evidence of their work and proof of knowledge, so the teacher has to be very clear in the expectations for students as they are asked to showcase what they have learned.

Another question that teachers must ask themselves for any type of assessment is, "How will this show students what and how I expect them to learn?" Vonderwell and Boboc (2013) answer this question by showing how two instructors of online courses use formative assessment successfully to improve student learning. Although these

educators are not physically in the classroom with their students, the objectives and media through which the course is taught is the same, as well as the truths about assessment and student learning. The authors write, "...formative assessment provides instructors with a more accurate representation of student gains in terms of knowledge and skills by using various strategies during the instructional process. Consequently, active learning is promoted by means of accommodating students' different learning styles, preferences, needs, and interests. At the same time, self-assessment, peer-assessment, collaborative work, and project-based learning are at the core of instruction, leading to a greater involvement of students in the evaluation of their own work and progress over time" (2013). Essentially, it is not just strong formative assessment practices that help facilitate learning, but it is the active use of many types of assessment practices that help students develop the skills necessary to best assess themselves and thrive in a classroom that uses an online curriculum. Teachers using online learning may have to teach students how to self-assess and behave in a productive collaborative working environment. Educators that are successful in teaching this to their students should see improvements in student learning.

What Can the Teacher Expect?

It is not conclusive whether teaching with an online curriculum is better or worse than teaching with a traditional printed text, but it is different. Educators familiar with more traditional means of teaching have to change their perspectives in order to be successful with online curricula. A teacher's creativity in instruction and in the use of visual representation might be replaced with the opportunity to be more imaginative in

lesson implementation and classroom management. A teacher might say she loses the joy she feels when she is the person explaining to students the same method she once learned. She might have to give up the brilliant lesson plan or activity she has used for numerous classes to incorporate the use of a new program. However, she can also approach the new technology with a desire to learn. She can learn to be passionate about a program alongside her students. Maybe the ideas the students encounter are not inherently hers, but she has to discover a way to make the curriculum successful for her, just like she did before. Maybe online curricula limit stress for teachers with time-constraints, and it might reduce some poor teaching habits. But it can also unite a school system, and allow teachers to discover new reasons to be excited and passionate about teaching.

As a young educator, Agile Mind was always a wonderful starting point for any of my lessons. The ready-made lesson plans, the assessment questions, and the topics' graphics stimulated my thought process for creating a captivating and meaningful experience for my students. I would review a topic and think, "What will my students find interesting? What parts of the program will get the attention of my students? What parts of the lesson are confusing? What should my students know after reading these slides?" Most importantly, I would always ask myself, "How can this online program work for me in my classroom?" Any curriculum, whether it is a traditional text or online resource, can be successful in educating young people. Teachers can use these curricula to form a cohesive learning opportunity for their students. However, it is critical to know how to adjust teaching styles so that these curricula can effectively transform the way educators deliver information and improve students' knowledge of mathematics.

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